Chapter 4

Execution

CAS provides the MAGTF with flexible, responsive fire support and is able to accurately employ a wide range of weapons. CAS can surprise the enemy and create opportunities for the maneuver or advancement of ground forces. CAS can protect flanks, blunt enemy offensives, and protect forces during a retrograde. More importantly, CAS may at times be the only supporting arm available to the commander. The following should be considered during CAS execution.

SECTION I. BASIC CONSIDERATIONS

SYNCHRONIZED TIMING

A common reference time is essential for accomplishing the high degree of coordination necessary for effective CAS. All participants—aircrews, terminal controllers, the TACC, the SACC, the DASC, and the FSCC—use the same timing method. There are two methods of timing: TOT and TTT. A synchronized clock using TOT is the standard method of timing aircraft attacks. The synchronized clock also solves the problem of coordinating a TOT “Hack” over several different radio nets. The ATO and OPORD should specify the clock time (local or Zulu) and should also identify the unit or agency responsible for coordinating the synchronized time. The synchronized clock is normally based on GPS or U.S. Naval Observatory time. Aircrews can update the clock on check-in with air control and fire support coordination agencies. Aircrews may request a TTT if preferred, or if they are unable to use a TOT.

Note: Zulu time is available from the U.S. Naval Observatory master clock as an automated, continuous broadcast on the following high frequency wavelengths: 5.000, 10.000, 15.000, 20.000, and 25.000 MHz. It is also available by telephone on DSN 762-1401 or (202) 762-1401. Alternatively, GPS satellites provide a standard time reference for using GPS equipment.

SECURITY

MAGTF commanders prescribe standardized cryptologic and authentication procedures in the OPORD and distribute updated instructions in the ATO, in special instructions, and in fragmentary orders (FRAGOs) to the MAGTF OPORD.

CHECK-IN

Check-in procedures are essential for establishing the required flow of information between CAS aircrews and control agencies. Control agencies should update all en route CAS aircrews on the current intelligence situation in the target area and on any changes to preplanned missions. The CAS check-in briefing format found in figure 4-1 is used on check-in with terminal controllers.

CLOSE AIR SUPPORT BRIEFING FORM

The CAS brief (Figure 4-2, page 4-4), also known as the “nine-line brief,” is the standard brief used for all aircraft conducting CAS. The brief is used for all threat conditions and does not dictate the

CAS aircrew's tactics. The mission brief follows the numbered sequence (1-9) of the CAS briefing form. Use of a standardized briefing sequence improves mission direction and control by allowing terminal controllers to pass information rapidly and succinctly.

(Aircraft Transmits to Controller)

Aircraft: ______________________, this is ______________________
(controller call sign) (aircraft call sign)

1. Identification/Mission Number: ______________________

Note: Authentication and an appropriate response are suggested here.
The brief may be abbreviated for brevity or security ("as fragged" or "with exception").

2. Number and Type of Aircraft: ______________________

3. Position and Altitude: ______________________

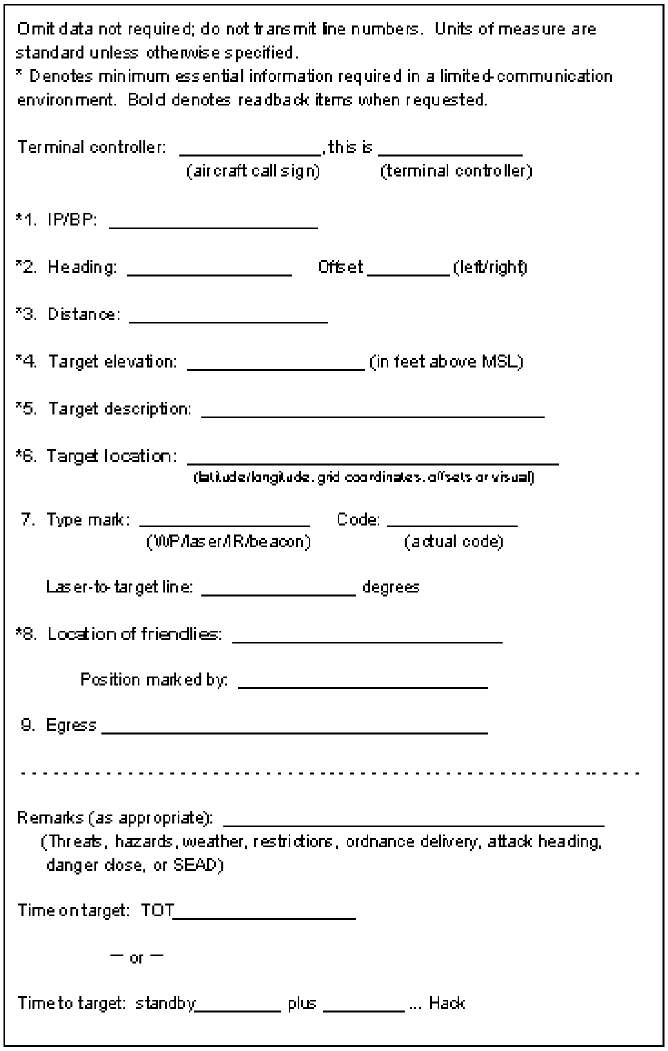
4. Ordnance: ______________________

5. Time on Station: ______________________

6. Abort Code: ______________________
(if applicable)

Figure 4-1. Close Air Support Check-In Brief.

This mission information and sequence may be modified to fit the tactical situation. The CAS briefing helps aircrews to determine the information required to perform the mission. When the terminal controller needs a confirmation that the aircrew has correctly received critical items of the brief, the terminal controller will request a "read back." When a "read back" is requested, the aircrew will repeat back items 1, 6, 8, and any restrictions. North Atlantic Treaty



Omit data not required; do not transmit line numbers. Units of measure are standard unless otherwise specified.
* Denotes minimum essential information required in a limited-communication environment. Bold denotes readback items when requested.

Terminal controller: ______________, this is ______________
(aircraft call sign) (terminal controller)

*1. IP/BP: ____________________

*2. Heading: ________________ Offset ________ (left/right)

*3. Distance: ____________________

*4. Target elevation: _________________ (in feet above MSL)

*5. Target description: _________________________________

*6. Target location: ___________________________________
(latitude/longitude, grid coordinates, offsets or visual)

7. Type mark: ________________ Code: ____________
(WP/laser/IR/beacon) (actual code)

Laser-to-target line: _______________ degrees

*8. Location of friendlies: __________________________

Position marked by: ________________________

9. Egress _____________________________________

- -

Remarks (as appropriate): _____________________________________
(Threats, hazards, weather, restrictions, ordnance delivery, attack heading, danger close, or SEAD)

Time on target: TOT__________________

— or —

Time to target: standby_________ plus ________ ... Hack

Figure 4-2. Close Air Support Briefing Form (9-Line).

Organization (NATO) check-in and CAS briefing formats differ slightly from the U.S. joint format. See Appendix G for NATO CAS briefing formats. The following paragraphs detail the line-by-line elements of the CAS brief:

- **IP/BP.** The IP is the starting point for the run-in to the target. For rotary-wing aircraft, the BP is where attacks on the target are commenced.

- **Heading.** The heading is given in degrees magnetic from the IP to the target or from the center of the BP to the target. Terminal controllers give an offset (offset left/right) if a restriction exists. The offset is the side of the IP-to-target line on which aircrews can maneuver for the attack.

- **Distance.** The distance is given from the IP/BP to the target. For fixed-wing aircraft, the distance is given in NM and should be accurate to a tenth of an NM. For attack helicopters, the distance is given in meters from the center of the BP and is accurate to the nearest 5 m.

- **Target Elevation.** The target elevation is given in feet above MSL.

- **Target Description.** The target description should be specific enough for the aircrew to recognize the target. The target should be described accurately and concisely.

- **Target Location.** The terminal controller can give the target location in several ways (e.g., grid coordinates, latitude and longitude, navigational aid fix, or visual description from a conspicuous reference point). Because of the multiple coordinate systems available for use, the datum that will be used must always be specified in the JTAR. If using grid coordinates, terminal controllers must include the 100,000-m grid identification.

For an area target, give the location of the target's center or location of the greatest concentration. For a linear target, give the location of the ends of the target.

- **Mark Type.** Mark type is the type of mark the terminal controller will use (smoke or laser) and the laser code (code) the terminal controller will use.

- **Friendlies.** The distance of friendlies from the target is given in meters and is a cardinal heading from the target (north, south, east, or west). If the friendly position is marked, identify the type of mark.

- **Egress.** These are the instructions the aircrews use to exit the target area. Egress instructions can be given as a cardinal direction or by using control points. The word "egress" is used before delivering the egress instructions.

- **Remarks.** The following information should be included if applicable:

  - Laser-to-target line (in degrees magnetic)
  - Ordnance delivery
  - Threat and location
  - Final attack heading (final attack cone headings)
  - Hazards to aviation
  - ACAs
  - Weather
  - Restrictions

- Additional target information
- SEAD and location
- Laser, illumination, and night vision capability
- Danger close.

- **TOT/TTT.** The terminal controller gives aircrew a TOT or TTT.
  - **TOT.** TOT is the synchronized clock time when ordnance is expected to hit the target. TOT is the timing standard for CAS missions. There is no time "Hack" statement when using TOT.
  - **TTT.** TTT is the time in minutes and seconds, after the time "Hack" statement is delivered, when ordnance is expected to hit the target. The time "Hack" statement indicates the moment when all participants start the timing countdown.

RISK-ESTIMATE DISTANCE

Troops in Contact

Terminal controllers and aircrews must be careful when conducting CAS when friendly troops are in direct contact with enemy forces. The terminal controller should regard friendlies within 1 km as a "troops in contact" situation and so advise the supported commander. However, friendlies outside 1 km may still be subject to weapons effects. Terminal controllers and aircrews must carefully weigh the choice of munitions and delivery profile against the risk of fratricide.

Danger Close

Ordnance delivery inside the 0.1% probability of incapacitation (PI) distance will be considered “danger close.” The supported commander must accept responsibility for the risk to friendly forces when targets are inside the 0.1% PI distance. Risk acceptance is confirmed when the supported commander passes his initials to the attacking CAS aircraft, signifying that he accepts the risk inherent in ordnance delivery inside the 0.1% PI distance. Risk-estimate distances allow the supported commander to estimate the danger to friendly troops from the CAS attack. Risk-estimate distances are listed in Appendix F. When ordnance is a factor in the safety of friendly troops, the aircraft’s axis of attack should be parallel to the friendly force’s axis or orientation. This will preclude long and/or short deliveries from being a factor to friendlies. Forward-firing ordnance such as 20-mm, 25-mm, or 30-mm cannon fire; Maverick missiles; or rockets should be expended with the ricochet fan oriented away from friendly locations.

TARGET MARKING

Target marking aids aircrews in locating the target that the supported unit desires to be attacked. Terminal controllers should provide a target mark whenever possible. To be effective, the mark must be timely and accurate. Target marks may be confused with other fires on the battlefield, suppression rounds, detonations, and marks on other targets. Although a mark is not mandatory, it assists in CAS accuracy, enhances situational awareness, and reduces the possibility of fratricide.

- **Mark Timing.** Laser marks are initiated by a 10-second warning and “Laser On” command from the CAS aircrew. IR pointers and indirect fire munitions marks (except illumination) should appear/impact 30 to 45 seconds before the scheduled CAS aircraft ordnance impact. Illumination rounds should impact in sufficient time before target engagement to allow the illumination flare to become fully visible. In high winds, the target mark should arrive closer to ordnance impact time (and upwind if possible) as the effects of the mark (smoke/dust) tend to dissipate rapidly. An exception is timing for standoff or precision guided weapons, which may require the mark up to 60 seconds before air-delivered ordnance impact. When the time of fall or time of flight of the weapon is greater than 15 seconds, the CAS aircrew should request an earlier mark. Delaying the request for a change to the standard mark timing will prevent proper coordination and can cause an aborted mission due to an inaccurate or missing mark.

- **Mark Accuracy.** The visual mark should impact within 300 m of the target to ensure a successful attack. Visual marks that land beyond 300 m from the target may not provide the CAS aircrew with a visual cue that allows attack of the correct target. The most accurate mark is a laser when the FAC or laser designator operator can maintain line of sight with the target. IR and munitions marks should be placed as near the target as possible to help ensure target identification.

- **Laser Marking.** Missions involving LGWs require coordination of laser-compatible designators, ordnance, and attack parameters. For preplanned missions, include the designation code in line 7 of the CAS briefing form. For immediate missions, the requesting unit includes the availability of a laser designator/code. If the aircraft has an LST, the preferred method of marking a target is by laser. The laser ensures the accurate engagement of the target by LGWs and assists the CAS aircrew in more accurately delivering unguided ordnance. If using lasers (ground or airborne) to mark the target, laser designation must be selective and timely because laser devices can overheat and lengthy laser emissions may compromise friendly positions. For laser marks, the aircrew will normally provide a 10-second warning to activate the mark. See section III of this chapter for more information.

- **IR Marking.** IR pointers and other IR devices can be used by terminal controllers to mark targets at night for aircrews who are using NVDs. Unlike laser designators, these IR devices cannot be used to guide or improve the accuracy of aircraft ordnance. Caution should be used when using IR pointers as they may expose the terminal controller to an enemy with night vision capability. IR marks should be initiated 20 to 30 seconds before the CAS TOT/TTT, or when requested by the aircrew, and continue until the aircrew transmits "Terminate" or the weapon hits the target. See section II of this chapter for more information.

- **Marking by Indirect Fire.** Artillery, naval gunfire, or mortar fires are an effective means of assisting aircrews in visually acquiring the target. Before choosing to mark by artillery, naval gunfire, or mortars, observers should consider the danger of exposing these supporting arms to the enemy's indirect fire acquisition systems and the additional coordination between supporting arms required for this mission. Munitions marking rounds should be delivered as close to CAS targets as possible, with white/red phosphorous marks timed to impact 30 to 45 seconds before the CAS TOT/TTT. Illumination marks should be timed to impact 45 seconds before the CAS TOT/TTT. This lead time ensures that the marking round is in position early enough and remains visible long enough for the terminal controller to provide final control instructions and for the aircrew of the lead aircraft to acquire the target. Indirect fire marking rounds are most effective when delivered within 100 m of the CAS target, but those within 300 m of the CAS target are generally considered effective enough to direct CAS aircraft. If the indirect fire marking round is not timely or accurate, terminal controllers should be prepared to use a backup marking technique or to rely completely on verbal instructions to identify the target to the CAS aircrews. If the situation requires a precise mark, observers or spotters can adjust marking rounds early to ensure that an accurate mark is delivered to meet the CAS schedule. This may, however, alert the enemy to an imminent attack.

- **Marking by Direct Fire.** Direct-fire weapons can be used to deliver a mark. Although this method may be more accurate and timely than an indirect fire mark, its use may be limited by range and the visibility of the weapon's burst effect on the battlefield.

- **Marking by Aircraft.** Aircraft may be used to deliver a mark. The preferred method is for FAC(A) aircraft to mark with white or red phosphorous, high explosive rockets, illumination, and/or lasers. See Appendix C for a complete listing of aircraft target marking capabilities.

- **Backup Marks.** Whenever a mark is provided, a plan for a backup mark should be considered. For example, artillery may be tasked to deliver the primary mark, while a mortar or aircraft may be assigned responsibility for the backup mark.

- **Additional Marking Techniques**

  - **Voice-Only.** In a medium- or low-threat environment, the terminal controller may "talk the aircrew onto the target" by verbally describing the target to be attacked. The standard brevity terms listed in figure 4-3 are used in these circumstances.

Call	Meaning
Visual	The terminal controller has the attack aircraft in sight, or the attack aircraft has positively identified the terminal controller's or friendly position.
Contact	Attacking aircraft acknowledges sighting of a specified reference point.
Tally	The enemy position/target is in sight.
Note: All terms may be further amplified by including additional words (e.g., "Tally Target").	

Figure 4-3. Standard Close Air Support Brevity Terms.

- **Combination.** When necessary, and when conditions permit, terminal controllers can use a combination of verbal and visual marking to aid in orienting CAS aircrews on the target.

- **Marking Friendly Positions.** Friendly forces can mark their own position with NVDs, IR strobes, smoke, signal panels, or a mirror. This achieves the same results as target marking as long as the mark is understood by the CAS aircrews. Marking friendly positions is the least desirable method of providing a target mark and should be used with caution because marking friendly positions can be confusing. This technique should be used only when no other method is available.

FINAL ATTACK CONTROL

After the aircraft depart the CP or HA, the terminal controller provides target and threat updates to the aircrews. The terminal controller may direct the aircrews to report departing the IP or arrival in the BP. This information may be used to coordinate the CAS attack with SEAD, marking, or the maneuver of the supported unit. The terminal controller attempts to acquire the CAS aircraft visually and give final corrections to assist in target acquisition by the aircrew. Corrections are given in two parts—direction and distance. Corrections from a visual mark will be passed by using the eight points of the compass and a common distance reference.

- **From Ordnance Impact.** Corrections can be made from the last ordnance to impact the target. (See figure 4-4.)

> "Blade 11, this is Tango Four Whiskey, from the mark, northeast—two hundred meters."

Figure 4-4. Correction From Ordnance Impact.

- **From a Reference Point**. Corrections can be made from a recognizable reference point. The terminal controller also selects a ground feature to establish a common distance reference. (See figure 4-5.)

> "T-bolt 22, this is Tango Four Whiskey. The tree line runs east to west. From the road intersection east to the bridge is one unit. From the bridge, the target is northeast three units."

Figure 4-5. Correction From a Reference Point.

Clearance to Drop/Fire

Responsibility for expenditure of ordnance rests with the ground commander. The terminal controller has the authority to clear aircraft to release weapons after specific or general release approval from the ground commander. Battlefield conditions, aircrew training, ordnance capabilities, and terminal controller experience are factors in the decision to authorize weapons release. The two levels of weapons release authority are positive control and reasonable assurance. A “Cleared Hot” clearance should be given as soon as possible in the delivery sequence after the terminal controller is convinced the attacking aircraft sees the target and will not release on friendly positions. This allows the aircrew to concentrate on the weapons solution and improves delivery accuracy, further reducing the possibility of fratricide.

Positive Control. Positive control will be used to the maximum extent possible. The terminal controller or an observer in contact with the terminal controller must be in a position to see the attacking aircraft and target and must receive verbal confirmation that the objective/mark is in sight from the attacking aircrew before issuing the clearance to drop/fire. A positive clearance by the terminal controller (“Cleared Hot”) is *mandatory* before any release of ordnance by the aircrew. The “Cleared Hot” call can be made only after the terminal controller confirms the aircraft is:

- On the proper attack heading
- Wings level
- Pointing at the correct target.

The terminal controller should request the following calls from the aircrew in the remarks portion of the CAS brief: “IP Inbound,” “Popping” or “In,” and “Wings Level.” This will facilitate positive control and aid the terminal controller in successfully conducting the CAS mission. Aircrew call “In” (commencing an attack run) using the format in figure 4-6. Following the “Wings Level” call, all other CAS aircrews should maintain radio silence, except to make threat calls, and allow the terminal controller to transmit the appropriate control and clearance communications listed in figure 4-7. During peacetime training/exercises, personnel involved in CAS missions follow training range regulations for the release of ordnance. The two methods of exercising positive control are direct and indirect control.

______ (call sign), in from _______ (cardinal heading).
Mark in sight/not in sight (if appropriate).

Figure 4-6. Attack Aircrew “In” Call Format.

- **Direct Control.** Direct control will be used whenever possible. It occurs when the terminal controller is able to observe and control the attack. The terminal controller transmits “Cleared Hot” when he sees the aircraft is attacking the correct target. There may be times when the terminal controller may not be able to see the attacking aircraft (because of high altitude, standoff weapons, night, or poor visibility). In these cases, clearance to drop will be given only if the terminal controller can use other means to confirm that the aircraft is attacking the correct target and has friendly positions in sight. These means include, but are not limited to, confirming with a verbal description that the aircraft has friendly positions in sight, the mark in sight, and the target in sight, as appropriate.

Call	Meaning
Continue	Continue the pass. You are not yet cleared to release any ordnance.
Abort (abort code)	Abort the pass. Do not release any ordnance.
Cleared Hot	Your are cleared to release ordnance on this pass.
Continue Dry	You are cleared to proceed with the attack run but you may not release any ordnance.
Warning The word "Cleared" will be used only when ordnance is actually to be delivered . This will minimize the chances of dropping ordnance on dry passes and further reduce the risk of fratricide.	

Figure 4-7. Terminal Controller's Calls.

- **Indirect Control.** Indirect control is not the preferred method of positive control. It is used when the terminal controller cannot observe the attack, but is in contact with someone who can. The terminal controller can issue clearance or abort the attack based on information from the observer. This form of control must be authorized by the ground commander.

- During combat operations, battlefield conditions such as communications jamming or low-altitude flight can prevent receipt of positive clearance to complete the attack. Commanders can establish guidelines that allow CAS aircrews to continue attacks on targets under such unusual circumstances.

Reasonable Assurance

Reasonable assurance is a circumstance under which the supported ground commander assumes an acceptable level of risk in allowing aircrews to attack targets by releasing ordnance *without* positive control. Specific employment criteria ensure that the supported ground commander, the terminal controller, and the aircrew are reasonably assured, *during each CAS mission*, that ordnance will not adversely affect friendly forces. Careful consideration must be given to using reasonable assurance in combat operations. Reasonable assurance is not a routine procedure. Reasonable assurance allows the delivery of ordnance without positive verbal clearance if the aircrew is reasonably assured that the proper target will be attacked.

Reasonable assurance is considered when the terminal controller, supported commander, and aircrews are confident the attack will not harm friendly forces. The MAGTF commander establishes the procedures for situations where reasonable assurance may be used. Precise guidelines for the use of reasonable assurance are established and distributed throughout the MAGTF and supporting forces.

Reattacks

Reattacks allow CAS aircraft to expeditiously maneuver, at the aircrew's discretion while in compliance with any restrictions in force, to a wings-level attack position subsequent to a CAS attack. Clearance for immediate reattack is issued by the terminal controller.

Each reattack is a separate evolution from any previous attack, and positive clearance is required each time. Clearance for a reattack does not obviate the need for another sequence of "Wings Level" and "Cleared Hot" calls by the aircrew and terminal controller. Once positioned for the reattack, the aircrew reports "Wings Level." As was required in the initial CAS attack, clearance to drop/fire on a reattack *must* be issued by the terminal controller before ordnance release. Clearance for reattack *is not* an indefinite clearance to drop/fire. Information regarding targeting (corrections, shift to new target, new restrictions) can be given to the aircrew during maneuvering. Positive confirmation of a subsequent target must be asked of and received from the aircrew if the target has changed.

ABORT PROCEDURES

The terminal controller must direct CAS aircrews to abort if they are not aligned with the correct target, if it appears that friendly troops may be endangered, or for the safety of the CAS aircrew.

Abort Code

The CAS abort procedure uses the “challenge-reply” method to authenticate the abort command. During the CAS check-in briefing, the flight lead gives the terminal controller a two-letter challenge code for use with his flight only. The terminal controller refers to his authentication document, finds the reply, and notes but does not transmit it. The reply “letter” becomes that flight’s abort code. If no abort code was briefed, then the CAS attack is aborted by simply transmitting, “Abort, Abort, Abort.” (See figure 4-8.)

The terminal controller is "DEVILDOG"; the CAS attack flight is "GUNRUNNER 31." GUNRUNNER 31 flight has chosen "BR" (authenticated "D") as its abort code.	
Radio Call	**Required Action**
(During the CAS check-in briefing): "DEVILDOG, this is GUNRUNNER 31, abort code Bravo Romeo."	DEVILDOG notes the correct reply for "BR" is "D".
(The CAS attack is in progress and the FAC calls for an abort): "GUNRUNNER 31, DEVILDOG, Abort Delta, Abort Delta, Abort Delta".	GUNRUNNER 31 is not cleared to release ordnance and discontinues the CAS attack.

Figure 4-8. Abort Call Example.

BATTLE DAMAGE ASSESSMENT

BDA is used to update the enemy order of battle. Accurate BDA is critical for determining if a target should be reattacked. The BDA should include:

- Information relating the BDA being given to a specific target (e.g., target coordinates, target number, mission number, munitions expended, or target description)
- Time of attack

- Damage actually seen (e.g., secondary explosions or fires, enemy casualties, or number and type of vehicles/structures damaged or destroyed)

- Mission accomplishment. (Were the desired effects achieved?)

Terminal Controller Responsibilities

Whenever possible, the terminal controller provides attack flights with the BDA of their attack as they egress. The terminal controller gives BDA for the flight, not for individual aircraft in the flight. At times, it may not be possible to pass all BDA information. At a minimum, the terminal controller should pass an assessment of mission accomplishment. Additionally, the terminal controller should provide all available BDA information to the DASC or appropriate C2 agency.

Aircrew Responsibilities

CAS aircrews use the MISREP to provide information on mission results (See figure 4-9.) Joint CAS missions use the abbreviated United States message text format (USMTF) in-flight report (INFLTREP). For more information on in-flight reporting, see Joint Pub 3-09.3. The MISREP should be sent directly to the supported unit or the DASC. Message recipients may provide additional information and forward it via another MISREP.
Note: See NWP 3-22.5-AH1, Vol. I, *AH-1 Tactical Manual*, for target area weather information (TARWI) code explanation and use.

Mission Report

_____________ , this is _____________ , Mission Number _____, MISREP to
(reporting agency) (call sign)
follow."

"Ready to Copy"

A. Location Identifier ______________________________

B. TOT/TOS/Time of Sighting ________________________

C. Results* ______________________________________

D. Other Information** _____________________________

E. TARWI Code (target area) _________________________

* Target Results/BDA.

** Vital intelligence, additional sighted enemy activity, and threat updates (times).

Figure 4-9. Mission Report Briefing.

SECTION II. NIGHT/LIMITED-VISIBILITY CLOSE AIR SUPPORT

The fundamentals of CAS during the day apply equally to CAS at night and during times of limited visibility. However, night and adverse-weather CAS demand a higher level of proficiency that can be realized only through dedicated, realistic CAS training. Night and limited-visibility CAS relies heavily on systems and sensors and makes terminal controller and aircrew proficiency critically important. Terminal controllers and aircrews must routinely train and exercise CAS procedures and equipment at night and in adverse weather conditions. Specific attack and delivery techniques for night/limited-visibility CAS vary depending on the aircraft. There are three general categories of night/limited-visibility employment: visual, system-aided, and NVG.

VISUAL EMPLOYMENT

During night visual employment, terminal controllers and aircrews must rely on lower ambient light conditions, battlefield fires, or artificial illumination to successfully attack targets. Threat permitting, the use of aircraft lights or flares may be required to see the CAS aircraft.

SYSTEM-AIDED EMPLOYMENT

Aircraft systems (radar, radar beacon, laser, FLIR, and TV) are relied on more at night and in adverse weather because of decreased visual target acquisition ranges and recognition cues. Aircrews and terminal controllers should incorporate redundant methods (e.g., radar, laser, and FLIR) in system-aided attacks while including a target mark when possible. The temptation to rely on a single system as an information source should be avoided.

NIGHT VISION GOGGLE EMPLOYMENT

NVGs are an additional sensor for aircrews. NVGs are used together with other systems to allow the detection and attack of targets at night. To fully exploit the potential of NVGs to enhance survivability and mission success, terminal controllers should be equipped with IR marking devices. Terminal controllers and aircrews must ensure that there is no confusion between conventional and NVG terms. Figure 4-10 lists night CAS brevity terms.

Term	Meaning
Rope	Call made by exception if the terminal controller is to illuminate the aircraft with an IR pointer.
Visual	The terminal controller has the attack aircraft in sight, or the attack aircraft has positively identified the terminal controller or friendly position.
Contact	Acknowledges sighting of a specified reference point.
Snake	Call made by exception for the terminal controller to oscillate the beam of an IR pointer about a target. This aids the aircrew in confirming the friendly position while helping maintain sight of the target during conditions when the IR beam/mark is difficult to see.
Sparkle	The terminal controller marks the target with an IR pointer.
Tally	Sighting of a target, bandit, bogey, or enemy position.
Steady	The terminal controller stops oscillation of the IR pointer.
Stop	The terminal controller stops IR illumination of the target.
Note: All terms may be further amplified by including additional words, for example "Contact, Road Intersection."	

Figure 4-10. Night IR Close Air Support Brevity Terms.

- **Friendly Marking.** Ground forces can illuminate their position with IR devices. These IR lights should be placed where aircrews overhead can visually acquire and maintain sight of friendly positions. During low illuminance levels, the entire IR beam will be seen with NVDs. The shape of the IR beam can be used to identify the terminal controller and target positions. The IR beam will appear narrower or pencil-like at the terminal controller's position and will appear wider near the target. IR pointers can also be used to direct NVG-equipped aircrews to the terminal controller's position by oscillating the IR pointer to designate to the aircrews the terminal controller's position (the nonmoving end of the pointer). Planning an attack axis (preplanned or as directed by the terminal controller) with only a small offset from the controller's pointer-to-target line can also help the aircrews confirm the controller's position.

- **Clearance Parameters.** Aircrews conducting night/limited- visibility CAS must be in positive communication with ground forces. When LTDs are employed, ground forces must hear "Spot," meaning the aircrew has acquired laser energy. When IR pointers are employed, ground forces must hear "Visual" (meaning the terminal controller's position is positively identified) and "Tally" (meaning the enemy position/target is positively identified).

- **CAS Briefing Form.** When using an IR pointer to mark a CAS target, indicate the target mark type in line 7 of the CAS briefing form as "IR" or "IR pointer." Include the pointer-to-target line in the remarks section of the CAS briefing form.

SECTION III. CLOSE AIR SUPPORT EXECUTION WITH LASER-GUIDED SYSTEMS

Laser-guided systems provide the MAGTF with the ability to locate and engage high-priority targets with an increased first-round hit probability. The accuracy inherent in laser-guided systems requires fewer weapons to neutralize or destroy a target. Laser-guided systems can effectively engage a wider range of targets, including moving targets. Laser-guided systems provide additional capabilities, yet have distinct limitations. This section provides CAS-specific TTP and background information on laser-guided system employment. See Joint Pub 3-09.1 for further information on lasers and laser employment.

BASIC REQUIREMENTS

There are five basic requirements for using LSTs or LGWs:

- Line of sight must exist between the designator and the target and between the target and the LST/LGW.
- The PRF codes of the laser designator and the LST/LGW must be compatible.
- The direction of attack must allow the LST/LGW to sense enough reflected laser energy from the target for seeker lock-on.
- The laser designator must designate the target at the correct time.
- The delivery system must release the weapon within the specific weapon's delivery envelope, while the spot remains on the target through weapon impact.

Environmental factors can affect laser designators and seeker head performance. Aircrews may be required to adjust tactics and techniques when accounting for low clouds and fog, smoke, haze, snow and rain, solar saturation, and other visually limiting phenomena.

LASER-GUIDED WEAPONS

All LGWs home on PRF-coded reflected laser energy. Some LGWs require target designation before launch and during the entire time of flight. Other LGWs require target designation only during the terminal portion of flight. All LGWs require designation through impact. Typical LGWs include the following:

- **Laser-Guided Bombs (LGBs)**
  - PAVEWAY I
  - PAVEWAY II
- **Low-Level LGBs**
  - PAVEWAY III
- **Laser-Guided Missiles (LGMs)**
  - AGM-65E Laser Maverick
  - AGM-114 HELLFIRE
- **Laser-Guided Projectiles**
  - COPPERHEAD

- Semi-active laser, general purpose.

LASER TARGET DESIGNATORS

Coded LTDs are ground and airborne systems that have two specific purposes. First, they provide terminal weapons guidance for LGWs. Second, they designate targets for coded LSTs. Coded LTDs emit laser energy with a particular PRF and require input of specific laser codes for operation. Codes that are assigned to LGWs correspond to the PRF that harmonizes the designator and seeker interface.

Coded LTDs used for terminal weapons guidance must be set to the same code as the LGW. Certain LGWs, such as LGBs, are coded before takeoff and cannot be changed once the aircraft is airborne. However, all coded LTDs, with the exception of the AC-130H, can change codes while in the tactical environment. (**Note:** The AC-130H's LTD is permanently preset with only one code (1688) and cannot be changed. Terminal weapons guidance of LGBs by an AC-130H is possible provided this code is set. The AC-130U has a codable LTD that allows code changes in flight). For more information on AC-130 employment see Appendix H. Laser code coordination is normally conducted through the joint ATD or CAS briefing form. A designator may serve the dual purpose of designating for an LST and terminal weapons guidance for LGWs. In these cases, the designator, the spot tracker, and the weapon must all have the same code.

The employment of LGBs in conjunction with coded LTDs is either autonomous or assisted. Autonomous LGB employment uses the CAS aircraft's on-board LTD for terminal weapons guidance. Most aircraft capable of delivering LGBs can provide on-board autonomous self-designation. Assisted LGB employment uses an off-board

LTD for terminal weapons guidance. This is typically accomplished by a ground team operating a designator (such as a MULE) or by another aircraft (known as "buddy lasing"). Assisted LGB employment is required by aircraft without on-board LTDs. These aircraft can carry and deliver LGBs but have no on-board terminal weapons guidance capability.

LASER SPOT TRACKERS

LSTs are systems that allow visual acquisition of coded laser-designated targets. LSTs must be set to the same code as the laser target designator for the aircrew to see the target being lased. In the case of airborne LSTs, the aircrew acquires the laser "spot" (target) and either delivers LGBs by using an LTD or executes visual deliveries with nonlaser ordnance. The aircrew can select PRF codes for the LST while in flight. See Appendix C for a listing of aircraft with LSTs.

LASER PROCEDURES

Attack Headings

Terminal controllers provide aircrews with an attack heading. The attack heading must allow acquisition of the reflected laser energy and should be outside the laser designator safety zone. The safety zone is defined as a cone (generally 20 degrees wide) whose apex is at the target and extends equidistant on either side of the target-to-laser designator line. This cone has a vertical limit of 20 degrees. Aircraft may engage targets from above the cone, as long as they remain above the 20-degree limit. The minimum safe altitude for aircraft will vary with the aircraft's distance from the target.

Aircrew may have difficulty determining the altitude required to remain above the 20-degree vertical limit; aircraft should therefore remain well above these altitudes or maintain the proper lateral separation from the safety zone. (See figure 4-11.)

Warning: The safety zone is not an absolute safety measure. In some situations, LSTs have acquired the laser energy caused by atmospheric scatter in front of the laser designator even though the LSTs were outside the safety zone.

At times, the tactical situation may dictate the use of the 20-degree safety zone. This will require extra caution as LGWs launched within the 20-degree safety zone could receive false target indications.

The optimal acquisition/attack zone is inside a 120-degree cone whose apex is at the target and extends to 60 degrees on either side of the target-to-laser designator line, excluding the 20-degree safety zone. This leaves an ideal attack zone of 50 degrees on either side of the safety zone. (See figure 4-12 on page 4-31.)

Generally, LST-equipped aircraft can operate throughout the optimal acquisition/attack zone without hazard to ground personnel operating LTDs. Risk to the laser designator operator may be reduced by increasing the delivery aircraft's altitude/offset angle or the designator-to-target distance.

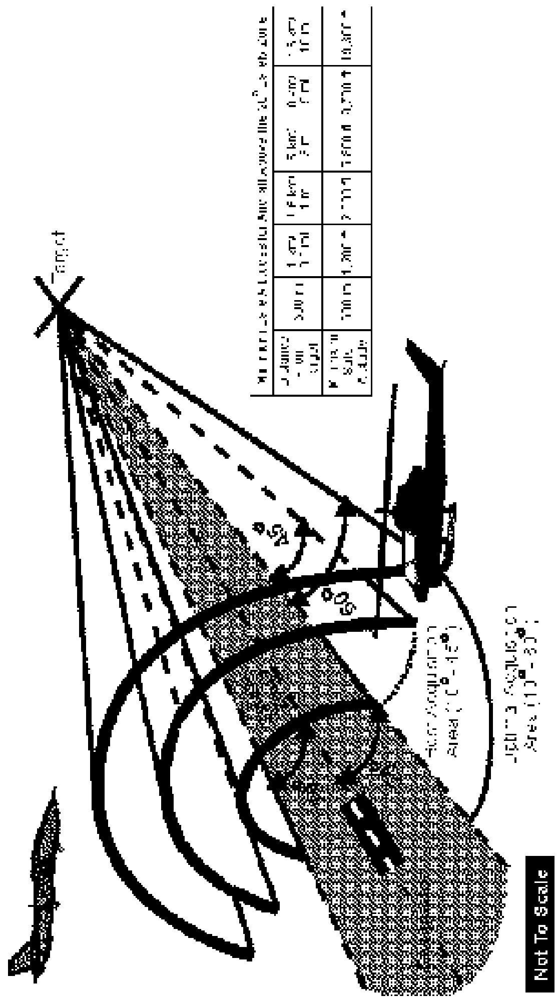


Figure 4-11. Laser Attack Headings and Safety Zone.

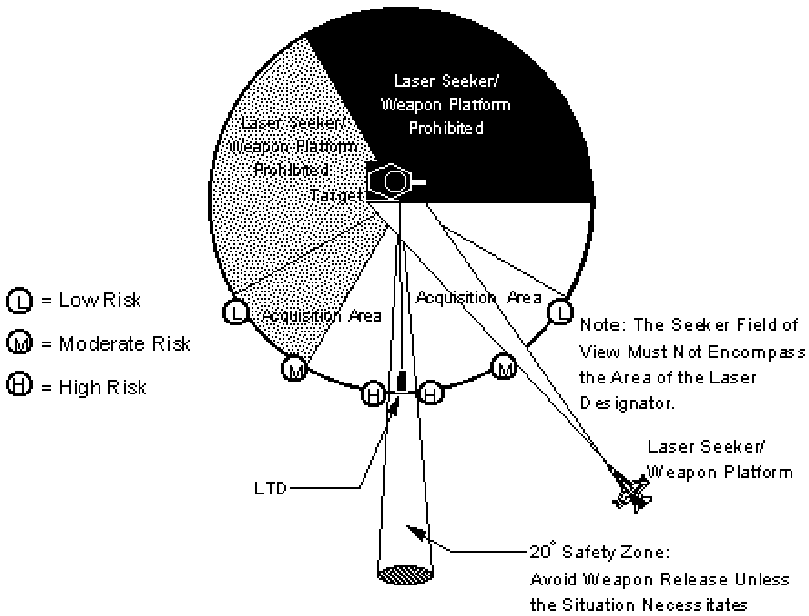


Figure 4-12. Safety Zone and Optimal Attack Zones.

Although increasing the delivery offset angle improves safety, it may degrade the LST's ability to acquire the laser spot. The best acquisition/attack area is therefore from 10 to 45 degrees on either side of the target-to-laser designator line.

Attack Angles

Aircrews release or launch LGWs so the target-reflected laser energy will be within the LGW seeker/LST field of view at the appropriate time. The allowable acquisition or attack angle (designator-to-target-to-seeker/LST) depends on the characteristics of the weapon system employed. If the angle is too large, the LGW seeker or LST will not receive enough reflected energy to sense the laser spot. In instances where the attack angle positions the weapon seeker or LST field of view to include the laser designator, atmospheric attenuation of laser energy near the designator aperture could cause LGW seeker or LST lock-on. *For this reason, aircrews should not use LSTs as the sole source for target verification*. The CAS aircrew should verify that they are attacking the correct target through additional means (such as visual description, terrain features, nonlaser target marks, etc.) to preclude inadvertent weapon seeker or LST lock-on at or near the designator. *Whenever possible, planned attacks should avoid placing the designator in the field of view of the LST or LGW*.

Coordination With Terminal Controller

Laser-guided systems improve the delivery accuracy of unguided ordnance. If the attack aircraft has an LST, the terminal controller can designate the target for aircrew identification. An aircrew can use the LST to visually locate the target. Once the target is located, the aircrew can conduct an accurate attack by using unguided ordnance. Aircraft equipped with LTDs can also be “talked onto” the target by the terminal controller, then designate the target and deliver the weapon by using their own spot. Final clearance to release still comes from the terminal controller. The standard laser brevity terms listed in figure 4-13 should be used.

Laser Designation Time

The aircrew may request a longer “laser-on” time based on munitions characteristics. If communications are unreliable, the terminal controller should begin designating 20 seconds before TOT or with 20 seconds remaining on TTT (unless the aircrew is using a loft delivery). Reducing laser operating time is important in a laser countermeasure environment or when using battery-operated designators. Offset lasing should also be considered where a target laser warning receiver capability exists. Nevertheless, designation time must be long enough to guarantee mission success.

Call	Meaning
Ten Seconds	Directive call to standby for "Laser On" call in approximately 10 seconds.
Laser On	Directive call to start laser designation.
Spot	Acquisition of laser designation.
Shift	Directive call to shift laser illumination.
Terminate	Cease laser illumination of the target.

Figure 4-13. Standard Laser Brevity Terms.

SECTION IV. FIXED-WING EXECUTION

This section identifies the TTP used by fixed-wing aircrews to conduct CAS. Standardized procedures and tactics provide a baseline for further refinement and improvement. Commanders should adjust these TTP as the combat situation develops. Aircrews can build on these basic TTP by using innovative thinking, experience, and the information from aircraft tactical manuals to improve CAS.

LAUNCH AND DEPARTURE PROCEDURES

Based on the recommendations by the GCE and ACE commanders, the MAGTF commander sets required response times for on-call aircraft. The appropriate air C2 agency issues launch orders to the ground alert aircrew. This may require land-line or courier communications.

EN ROUTE TACTICS (BEFORE THE CONTACT POINT)

Ideally, en route tactics allow CAS aircrews to avoid concentrated enemy air defenses and prevent early enemy acquisition of the attack force. If en route tactics are successful, they can delay or hamper enemy air defense coordination and increase aircrew survival and mission success.

Techniques

Aircrews and mission planners use support aircraft and other countermeasures to degrade the threat. Aircrews, terminal controllers, and air controllers select routes that avoid known threat weapon envelopes. Routes should include course changes to confuse and deceive the enemy concerning the intended target area. Aircrews use formations that complicate enemy radar resolution and improve lookout capability against enemy fighters. Aircrews constantly watch for air defense weapons. Aircrews use electronic protection and radar warning receiver/radar homing and warning equipment to detect and defeat enemy air defense systems. Aircrews should delay entry into a heavily defended target area until they have a clear understanding of the mission.

Navigation

En route navigation tactics depend on the threat, the need for and availability of support aircraft, friendly air defense requirements, weather, and fuel. En route navigation tactics include the use of high altitude, medium altitude, low/very low altitude, or a combination of the above.

- **High Altitude.** High-altitude en route tactics are flown higher than 15,000 feet above ground level (AGL). Aircrews use high-altitude tactics to remain above short-range air defenses. Advantages of high-altitude tactics include:

    - Reduced fuel consumption rate

    - Reduced navigation difficulties

    - Improved formation control

    - Increased maneuver airspace, which allows aircrews to concentrate on mission tasks instead of terrain avoidance tasks

- Improved communications, unaffected by terrain, between aircrew and control agencies

- Reduced exposure to certain AAA and man-portable IR SAMs.

- Disadvantages of high-altitude tactics include:

  - Enemy acquisition radar can detect the attack force at long range. (This allows the enemy to prepare its air defenses.)

  - The attack force may be vulnerable to some enemy SAM systems and enemy fighter interceptors before entering the target area if local air superiority has not been achieved.

  - Weather may prevent visual navigation and obscure the target area.

- **Medium Altitude.** Medium-altitude en route tactics are flown between 8,000 feet AGL and 15,000 feet AGL. Medium-altitude tactics may not be advisable in a medium- or high- threat environment. Medium-altitude tactics have many of the same advantages and disadvantages as high- and low-altitude tactics.

- **Low/Very Low Altitude.** Low-altitude en route tactics are flown below 8,000 feet AGL. Very low altitude is flight below 500 feet AGL. Aircrews use low-/very-low-altitude tactics to keep the attack force below enemy early warning/ground-control intercept (GCI) radar coverage for as long as possible. Adverse weather can cause aircrews to use low-/very-low- altitude navigation. Advantages of low-/very-low-altitude tactics include:

  - Reduced enemy radar detection by using the earth's curvature for masking

- Reduced chance of attack from enemy SAW systems by using terrain for masking

- Degraded enemy GCI radar coverage (This denies intercept information to enemy fighters and forces enemy aircraft to rely on visual or onboard acquisition systems.)

- Reduced enemy weapons envelope lethal zones during high-speed, low-altitude ingress

- Improved friendly aircraft maneuvering performance.

- Disadvantages of low-/very-low-altitude tactics include:

  - High fuel consumption rates

  - Extremely demanding navigation that requires a high level of aircrew skill (Navigation is easier for aircraft equipped with INS or GPS.)

  - Increased exposure to small arms, AAA systems, and IR-guided weapons

  - Difficulty in communication and control

  - Reduced target acquisition.

- **Combination of Low/Very Low, Medium, and High Altitude.** Aircrews combine low-/very-low- and medium-altitude tactics to gain the advantages of both while reducing the disadvantages of each. The en route portion of the flight is normally beyond the range of enemy air defense weapons and flown at a medium or high altitude. The attack force descends to low/very low altitude to avoid detection by certain enemy SAM threats and/or gain surprise.

INGRESS TACTICS (CONTACT POINT TO INITIAL POINT)

Ingress tactics apply from arrival at the CP until the target attack phase begins at the IP. The expected threat intensity and sophistication influence the selection of ingress tactics. Terminal controllers and aircrews tailor communications and control requirements to counter the threat. Normally, control of CAS flights is handed over to the terminal controller at the CP. In an intense jamming environment, preplanned scheduled missions may be the primary CAS method. Proper planning provides for mission success even if there is little or no chance of radio communications after the flight becomes airborne.

Navigation

Ingress tactics depend on the threat, the need for and availability of support aircraft, weather, and fuel. Ingress navigation tactics include high altitude, medium altitude, low/very low altitude, and a combination of low/very low and medium altitude.

- **High Altitude.** Aircrews use high-altitude ingress tactics to remain above the enemy AAA and short-range SAM threat. High-altitude ingress reduces fuel consumption rates and eases navigation.

- **Medium Altitude.** Medium-altitude ingress tactics are a continuation of medium-altitude en route tactics. Aircrews can use medium-altitude ingress tactics if support aircraft, air strikes, artillery strikes, or onboard electronic protection equipment can suppress the enemy air defense threat or if they can remain above the enemy SAW threat. Medium-altitude ingress reduces fuel consumption rates and eases navigation. These tactics may provide better CAS for the requesting commander than low-/very-low-altitude methods.

- **Low/Very Low Altitude.** In high- and medium-threat environments, aircrews use low-/very-low-altitude ingress tactics to degrade enemy detection capabilities. These tactics can increase aircrew survivability but also increase fuel consumption rates. Extensive training is required to develop accurate navigation techniques and the ability to perform effective evasive maneuvers. Detailed planning is critical. Aircrews plot, brief, and study the ingress routes to gain the maximum advantage from terrain masking.

  Extreme terrain can dictate that the size of each attack element be small if flying low/very low altitudes. The terrain dictates the type of formation flown by the attack element.

  Fixed-wing aircrews must maintain adequate clearance from helicopter flights. Helicopter aircrews using terrain flight (TERF) techniques must remain close to the terrain. This becomes critical when fixed-wing aircrews traverse vertically-developed terrain.

- **Combination Low/Very Low and Medium Altitude.** The attack force enters the target area at low/very low altitude to avoid early enemy radar detection. At a predetermined point, the attacking force climbs to medium altitude for the attack.

  This tactic protects the attack force from early engagement by enemy long-range SAW systems and fighter aircraft. The climb to medium altitude removes the attack force from the low-altitude AAA and short-range IR missile envelopes and aids target acquisition. This tactic does increase the attacking force's vulnerability to SAW systems in the target area but is designed to beat SAW system reaction times.

Aircrews should consider this tactic when AAA is the major threat in the target area. This tactic includes climbing to a medium altitude before entering the lethal zone of LAAD weapons. The climb should be delayed as long as possible to reduce vulnerability to long-range air defense systems.

- **Communications and Control.** Communications and control procedures at the CP vary by the type of CAS, the threat, the support package, communication capabilities, and planned ingress tactics. A preplanned, scheduled mission may require little or no communications. However, an immediate mission will probably be very communications-intensive. In the presence of an EW threat, communications discipline becomes more important, as effective communications may be considerably more difficult to conduct.

  - **Mission-Essential Information.** The aircrew must receive mission-essential information before arriving at the target area. If communications at the CP permit, missions may be launched without specific targets or IP assignments. Such flights receive only a CP and a terminal controller call sign/frequency either before launch or from an air control agency once airborne. The aircrew receives the rest of the target brief at the CP. Aircrews may have to divert or abort if they are unable to receive mission-essential briefing items.

  - **Flexible Communications.** Communications between the aircrew and the terminal controller may be difficult or nonexistent. If the terminal controller cannot talk to the aircrew, the appropriate air control agency must pass mission-essential information.

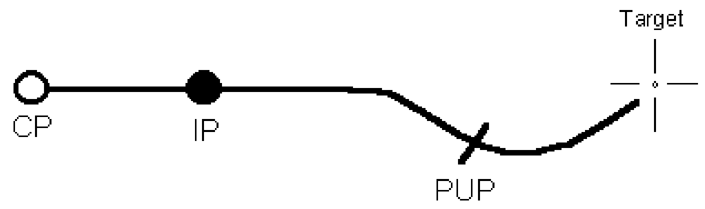
  - **Minimum Communications.** Preplanned, scheduled missions leave the CP to meet a TOT/TTT with minimal communications. The terminal controller makes brief, coded transmissions or assignment changes. Airborne alert aircraft remain at a CP for immediate mission assignment. Aircrews given immediate CAS missions plan fuel or time cutoff points. The CP location may not allow communication between aircrews and terminal controllers because of radio range or line-of-sight considerations. Aircrews should expect communication problems and plan to use other air control agencies to provide radio relay.

ATTACK PHASE (INITIAL POINT TO TARGET)

The attack phase, or the final run-in from the IP to the target, is the most crucial phase of the CAS mission. Aircrew tasks increase because the aircrew must follow a precise timing and attack profile to produce the necessary effect on the target in a timely manner. Figure 4-14 illustrates the attack phase of a typical fixed-wing CAS mission.

Attack Tactics

Attack tactics permit integration of CAS attacks into fire support plans. Specific techniques used to attack a target are the choice of the pilot in command or the mission commander. Because of the risk to friendly ground forces, the FAC should avoid loft attacks with weapons release behind friendly positions.



To perform a CAS attack, the following actions must take place:

1. The attack aircrew receives the CAS brief.

2. The aircrew calculates the following, based on aircraft type, run-in airspeed, ordnance, and delivery maneuver.

a. Time to go/time to leave the CP to cross the IP at the proper time.
b. Distance and time from IP to target.
c. Degrees to turn at IP and direction of offset, if not directed by the terminal controller.
d. Distance/time to pull-up point (PUP) from the IP.
e. Pull-up angle (as applicable).
f. Apex/roll-in altitude (as applicable).
g. Release altitude (based on threat, friendly fires, and ordnance).

3. Terminal controller provides:

a. Mark on target 30 seconds before TOT/TTT.
b. Final corrections/directions (given concisely in cardinal direction and distance from the mark) to the aircrew to help find the target.
c. Clearance to deliver ordnance.

Figure 4-14. Key Actions in a Fixed-Wing Close Air Support Attack.

- **High/Medium Altitude.** High-/medium-altitude attacks are normally executed in a low-/medium-threat environment. However, aircrews can perform a high-/medium-altitude attack after any type of ingress. High-/medium-altitude attack advantages and disadvantages are similar to those listed in the discussion on en route tactics. More time may be available for target acquisition, but bombing accuracy may be degraded. Terminal controllers can issue to aircrews minimum altitude restrictions that reduce aircraft vulnerability to indirect fires. High-/medium-altitude tactics may prevent the terminal controller from visually acquiring the aircraft.

- **Low/Very Low Altitude.** During low-/very-low- altitude attacks, the same considerations apply as in high-/medium-altitude attacks. Aircrews may have less time to acquire the target and position their aircraft for a successful attack. When planning ordnance and attack profiles, consider the requirement for fragmentation pattern avoidance in the low-altitude environment.

- **Multiple Axes of Attack.** Tactical formations using multiple axes of attack provide effective mutual support throughout the attack. Multiple axes of attack increase the concentration of ordnance on target and force the enemy to split air defense assets. The size of the attack force depends on control requirements, time of exposure to enemy defenses, and time available in the target area. Multiple axes of attack depend on the threat. Regardless of the attack profile, the briefing format remains the same.

  - **Deconfliction Procedures.** The following procedural guidelines are considered standard: Aircraft in the route of egress from the target must have the right-of-way; reattacks must be approved by the terminal controller after coordination with the ground force commander; if an aircraft enters another flight's sector, the aircrew must immediately notify the other flight, the terminal controller, and deconflict or exit that sector; munitions that may enter the other flight's sector must be coordinated before the attack.

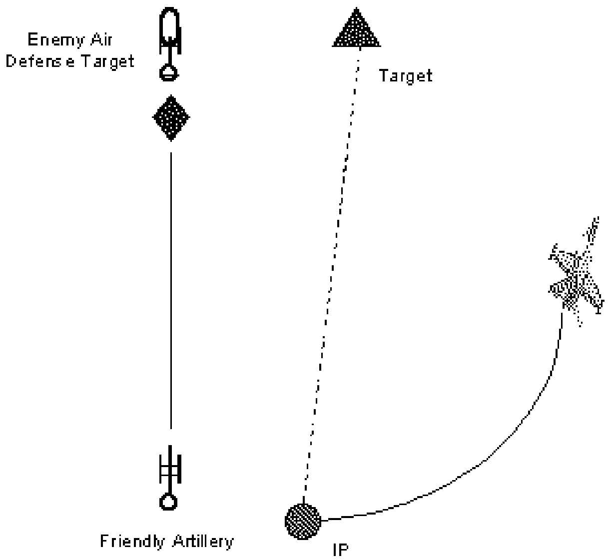
Procedural Control Measures

Terminal controllers use procedural control measures to provide target orientation for the aircrew; to align aircraft for the attack or egress; to provide separation from other supporting fires; to provide separation from enemy air defense weapons; and to provide procedural control measures that include IP selection, offset direction, and attack heading.

- **IP Selection.** The terminal controller selects the IP based on enemy capabilities, target orientation, friendly location, weather, and fire support coordination requirements. IPs should be radar- and visually-significant and normally located from 5 to 15 NM or 1 to 2 minutes from the target. If aircrews are not restricted, they are free to ingress and attack the target from any direction after they leave the IP. Attacks should have as few restrictions as possible.

- **Offset Direction.** The offset direction tells the aircrews on which side of the IP-to-target line they can maneuver for the attack. See figure 4-15 to understand the relationship between offset direction and IP-to-target heading. Terminal controllers use an offset direction to ease fire support coordination, aid target acquisition, align the aircraft for the attack or egress, or keep aircrews away from known threats.

  An offset direction aids fire support coordination by restricting aircrews from using airspace on the other side of the IP-to-target line. An offset direction keeps aircraft clear of enemy air defenses and reduces interference with gun target lines. It also reduces an aircrew's chance of being hit by direct/indirect fires. The offset direction regulates the attack quadrant without assigning a specific attack heading.



Offset Right Example

Plot an IP and a target and connect them with a straight line. Specify the offset direction as either right or left. If told to offset right, as in the example above, proceed on or to the right of this line while inbound to the target. Aircrews cannot fly to the left of this line. An offset restriction applies from the time aircrews leave the IP until ordnance is released and egress begins.

Figure 4-15. Offset Direction.

Types of Delivery

- **Level Delivery.** Ordnance is delivered with a wings-level pass over the target.

- **Dive Delivery.** Ordnance is delivered by using a dive delivery.

- **Loft Delivery.** To execute a loft delivery, the aircrew proceeds inbound to the target from the IP. At a calculated point, the aircrew starts a loft maneuver pull up. Once released, the weapon continues an upward trajectory while the aircrew egresses the target area. After the weapon reaches the apex of its trajectory, it follows a ballistic path to impact. (**Note:** If the delivery is conducted over friendlies, ground commander approval is required.)

- **Pop-up Delivery.** To execute a pop-up delivery, the aircrew proceeds to the target from the IP at low/very low altitude. As the aircrew nears the target, they pop up to the desired altitude and execute a dive delivery.

Final Attack Heading

A final attack heading is the assigned magnetic compass heading that an aircrew flies during the ordnance delivery phase of the attack. Terminal controllers assign final attack headings for several reasons: to increase ground troop safety, to aid in laser spot or target acquisition, and to help fire support coordination.

Final attack cones may be used to satisfy the same requirements of the final attack heading while offering increased flexibility. A final attack cone is an assigned range of magnetic compass headings that an aircrew may fly during the ordnance delivery phase of the CAS attack. The terminal controller assigns the magnetic headings for the left and right boundaries of the cone (e.g., “restriction— final attack heading between 090 degrees and 135 degrees”). This limits the CAS aircraft to the range of final attack headings falling within, and inclusive of, the boundary headings. This technique may aid the terminal controller in visually acquiring the aircraft while increasing CAS aircrew flexibility and survivability.

Immediate Reattacks

The aircrew's goal is to complete a successful attack on the first pass. Once acquired by the enemy in the target area, an aircraft that remains for reattacks may be more vulnerable. In low- and medium-threat environments, immediate reattacks may be a practical option, although single-pass attacks require less time in enemy air defense envelopes. A reattack can help assure the desired effect on the target, aid visual orientation for the aircrew, and increase responsiveness to the supported commander.

- **Terminal Controller Responsibilities.** Terminal controllers authorize reattacks. If a reattack is necessary and possible, the terminal controller may give the aircrew a pull-off direction and may assign different attack headings. The terminal controller may provide additional target marks for the reattack. The terminal controller can describe reattack target locations by using the last mark, last hit, terrain features, or friendly positions. The reattack may engage other targets within a specific target area.

- **Reduced Threat Considerations.** Often threat conditions allow aircrews to loiter safely in the target area. This may be a high loiter, to stay above effective AAA fire, or a lower loiter if there is no effective AAA threat. In this case, a "wheel" may be flown around the target. Advantages are:

  - Continued observation of the target area, the marks, and hits from other aircraft by all flight members

- Improved mutual support
- Increased ability to roll-in from any axis requested by the terminal controller
- Lower fuel consumption and increased TOS
- Easier timing of TOT
- Better ability to conduct reattacks.

FIXED-WING LASER-GUIDED SYSTEM EMPLOYMENT

Laser systems offer improved CAS weapons delivery capability and accuracy. However, they require detailed coordination and additional procedures. See Joint Pub 3-09.1 for more information.

Types of Employment

- **Laser Acquisition and LGWs.** Typically, this combination requires the longest period of laser designation and can provide the best results. Laser designation must allow the aircraft's LST adequate time to find the target. Laser designation may begin 20 seconds before planned TOT/TTT. Designation continues until ordnance impact. If communications permit, the aircrew may give "10 Seconds," "Laser On," "Spot," and "Laser- Off" calls.

- **Laser Acquisition and Unguided Weapons.** This combination produces excellent results if the delivery aircraft has some type of computer-aided release system. Laser designation can begin before or shortly after the aircraft crosses the IP. The aircrew may give a “Laser On” call if communications permit. Designation continues until all ordnance has impacted the target or the aircrew calls “Terminate.”

- **LGWs Only.** This combines “dumb” aircraft (no LST or LST failure) and “smart” (laser-guided) weapons. A supplemental mark (e.g., smoke) must be visible to the aircrew for them to be able to locate the target. Unless coordinated otherwise, designation should begin with ordnance release and continue until impact.

Employment Considerations

- **LGBs.** If designating for LGBs, terminal controllers and designator operators must consider the following:

  - Older LGBs have preset codes that cannot be changed.

  - Some newer LGBs have codes that are manually set before the aircraft launches. *Aircrews cannot change these codes while airborne.* On check-in, aircrews pass the designator code to the terminal controller.

  - Certain aircraft/LGW combinations allow in-flight cockpit selection of codes.

  - The terminal controller selects the IP/offset to ensure that the attack heading allows LST lock-on and ordnance delivery on the first pass.

  - Aircraft carrying both guided and unguided ordnance release LGBs first. This allows the LGB a relatively dust- and debris-free environment and helps reduce interference. Unguided bombs are dropped during later passes.

- LGBs provide greater accuracy.

- Because there is an increased hazard to friendly forces when aircrews release weapons behind friendly lines, the approval of the ground commander is required.

- Designators should coordinate “Laser On” times with the aircrew. The aircrew provides “Laser On” and “Laser Off” radio calls to the designator.

- **LGMs.** LGMs for fixed-wing aircraft include the AGM-65E Maverick. LGMs generally provide greater standoff launch ranges than LGBs. Greater range provides increased survivability for aircrews operating in a high-threat environment. Aircrews and terminal controllers must exercise caution when launching LGMs from behind friendly troops. Without a TOT or TTT, the aircrew gives a “10 Seconds” warning call to the terminal controller. This alerts the terminal controller to begin laser designation in 10 seconds. The aircrew gives a “Laser On” call to begin target designation. The aircrew may call “Laser Off” to end designation.

- **Laser Maverick Employment.** The Maverick system allows aircrews to engage targets designated by either air or ground sources with in-flight selectable PRF codes. In the event that the laser signal is lost, the weapon will safe itself and overfly the target. The missile and the laser designator must be set to the same PRF code before launch, and the missile must be locked-on to a laser source before launch. For other than self-designation, the attack heading must be adjusted to optimize the reflected laser energy.

- **Attacks by Multiple Aircraft.** Use of laser designators and LST-equipped aircraft simplifies rapid attacks by multiple aircraft. If numerous aircraft operate under the control of a single terminal controller and use the same heading (threat permitting), it simplifies control of the attack.

- **Attacks on a Single Target.** Multiple aircraft attacking a single target increase the chance of target destruction at the earliest possible time. The attack requires a single designator with one (or all) aircraft achieving lock-on and ordnance release. The terminal controller may clear the second aircrew to perform a follow-up attack on the target using guided or unguided ordnance.

- **Attacks on Multiple Targets.** Multiple aircraft attacking multiple targets require increased coordination and planning. Attacks on multiple targets can be performed by using a single designator or multiple designators. Separate designators on different codes for each target are preferred. Using multiple designators reduces the time any single designator is on and exposed to enemy countermeasures.

EGRESS

In a high-threat environment the need for a rapid egress may delay the ability to rendezvous and regain mutual support. Egress instructions and RPs should avoid conflict with ingress routes and IPs. Egress instructions may be as detailed as ingress instructions. Egress fire support coordination and deconfliction requirements are the same as those used during ingress. On completion of the mission, aircrews follow the egress instructions and either execute a reattack, return to a CP for future employment, or return to base.

SECTION V. ROTARY-WING EXECUTION

Rotary-wing CAS execution differs in some aspects from fixed-wing CAS execution primarily because of the difference in aircraft performance and flight regimes. This section identifies some of the TTP that attack helicopter aircrews can use to perform the CAS mission. These TTP should not be interpreted rigidly. Rigid standardization reduces flexibility and results in predictability. However, CAS TTP involve close coordination between ground units, aircrews, and control agencies, and therefore some standardization is necessary. Standard tactics provide aircrews with a baseline for further refinement and change. Operation plans and orders reflect initial standardization criteria. Commanders should adjust these procedures as the tactical situation dictates. Aircrews take advantage of initiative, imaginative thinking, experience, and basic aviation tactics found in aircraft tactical manuals to refine and improve mission tactics.

LAUNCH AND DEPARTURE PROCEDURES (TAKEOFF TO RENDEZVOUS POINT)

Rotary-wing aircraft should be positioned near the supported commander to reduce response time or increase TOS. The appropriate controlling agency issues launch orders through the proper C2 or fire support agency.

EN ROUTE TACTICS (RENDEZOUS POINT TO HOLDING AREA)

Ideally, en route tactics (route and altitude selection, TERF profile, and formations) allow rotary-wing aircrews to avoid concentrated enemy air defenses and prevent early enemy acquisition of the attack force. If en route tactics are successful, they can delay or hamper enemy air defense coordination and increase aircrew survival and mission success.

Navigation

En route navigation tactics depend on the threat, the need for and availability of support aircraft, friendly air defense requirements, weather, and fuel. In some circumstances, missions may be conducted above TERF altitudes (1,500 feet and above). Examples are missions during which the enemy threat consists of small arms only and during which early detection of CAS aircraft would not adversely affect mission accomplishment. Otherwise, as rotary-wing CAS aircraft approach the target area or probable point of enemy contact, they fly lower and with increased caution to arrive undetected in the HA. Aircrews use TERF to deny/degrade the enemy's ability to detect or locate the flight visually, optically, or electronically. En route TERF profiles fall into three categories: low level, contour, and nap of the earth (NOE).

- **Low Level.** Low-level flight is conducted at a constant airspeed and altitude above MSL. Low-level flight reduces or avoids enemy detection or observation. Aircrews use low-level flight to reach a control point in a low-threat environment.

- **Contour.** Contour flight conforms to the contour of the earth or vegetation to conceal the aircraft from enemy observation or detection. Contour flight uses varied airspeeds and altitudes above MSL as vegetation and obstacles dictate. Aircrews vary MSL altitude to produce constant altitude AGL. Aircrews use contour flight until reaching a higher threat area.

- **NOE.** NOE flight is as close to the earth's surface as vegetation and obstacles permit while following the earth's contours. Terrain and vegetation provide the aircraft with cover and concealment from enemy observation and detection. NOE flight uses varied airspeeds and altitudes AGL based on the terrain, weather, ambient light, and the enemy situation. When flying NOE, aircrews may maneuver laterally within a corridor that is compatible with the ground scheme of maneuver and assigned route structures. Within the corridor, aircrews use a weaving, unpredictable path to avoid detection by the enemy. NOE flight should be used in high-threat environments.

INGRESS TACTICS (HOLDING AREA TO BATTLE POSITION)

Ingress tactics apply from arrival at the HA until the target attack phase begins at the BP.

Control Points

Terminal controllers and aircrews select HAs and BPs that are tactically sound, that support the scheme of maneuver, and that are coordinated with other supporting arms. Rotary-wing CAS can be performed with or without HAs or BPs.

- **HAs.** HAs may be established throughout the battlefield to be used for rotary-wing aircraft awaiting targets or missions. These HAs serve as informal ACAs while they are in use. HAs provide the rotary-wing CAS aircrew with an area in which to loiter. HAs may be established during planning, referred to by name or number, and activated/established during operations.

- **BPs.** BPs are maneuvering areas that contain firing points for attack helicopters. Like HAs, BPs serve as informal ACAs while in use. Planning considerations and methods of establishment for BPs are the same as those used for HAs.

- **IPs.** IPs may be used by rotary-wing aircraft in the same manner as they are used by fixed-wing CAS aircraft. Rotary-wing aircraft proceed from an HA/BP to the IP to commence a running fire attack.

Techniques of Movement

Due to proximity to the threat, aircrews use TERF to move from the HA to the BP. If aircrews are close to friendly artillery and mortars, they use TERF in conjunction with airspace control measures to deconflict with artillery and mortar trajectories. Aircrews use three techniques of movement in TERF: traveling, traveling overwatch, and bounding overwatch. When flying TERF, rotary-wing aircraft movement must be coordinated with the applicable FSCC/SACC. (See figure 4-16.)

Techniques of Movement	Likelihood of Contact	TERF Profile
Traveling	Remote	Low Level or Contour
Traveling Overwatch	Possible	Contour or NOE
Bounding Overwatch	Imminent	NOE

Figure 4-16. Movement Techniques.

- **Traveling.** Traveling is a technique that aircrews use when the possibility of enemy contact is remote. The flight moves at a constant speed using low-level or contour TERF. Movement should be as constant as the terrain allows. Traveling allows rapid movement in relatively secure areas.

- **Traveling Overwatch.** Traveling overwatch is a technique that aircrews use when enemy contact is possible. The flight moves by using contour or NOE TERF. Although caution is justified, speed is desirable. The flight consists of two major elements: the main element and the overwatch element. The overwatch element may contain multiple subelements. The main element maintains continuous forward movement. The overwatch elements move to provide visual and weapons coverage of the main element. The overwatch elements provide weapons coverage of terrain from which the enemy might fire on the main element.

- **Bounding Overwatch.** Bounding overwatch is a technique that aircrews use when enemy contact is imminent. The flight moves using NOE TERF. Movement is deliberate, and speed is not essential. The flight consists of two elements. One element moves, or "bounds," while the other element takes up an overwatch position. The overwatch element covers the bounding elements from covered, concealed positions that offer observation and fields of fire.

Communications and Control

A rotary-wing aircraft's inherent flexibility allows a variety of communication and control procedures. TERF techniques of movement restrict the terminal controller's ability to exercise control through radio communications. Typically, communications may not be desirable during the ingress phase. To preserve operational security, aircrews can land to receive face-to-face mission briefs and mission-essential information from the supported commander or terminal controller before leaving the HA. An airborne relay may be used to maintain communications.

ATTACK PHASE (WITHIN THE BATTLE POINT)

The attack phase is the most important phase of the rotary-wing CAS mission. The attack must produce the necessary effect on the target in a timely manner. Figure 4-17 illustrates an example of a rotary-wing CAS attack.

Control

Once the aircrews reach the BP, the terminal controller or mission commander issues final instructions to the flight. Aircrews select individual FPs and remain masked while awaiting the TOT/TTT.

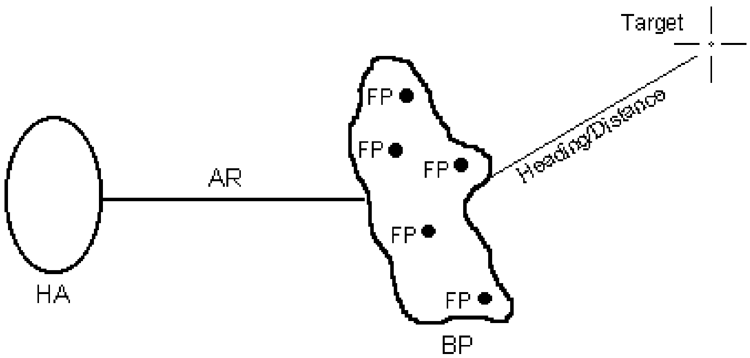


Figure 4-17. Rotary-Wing Close Air Support Attack Phase Example.

Attack Tactics

The specific techniques used to attack a target are the choice of the AMC. Attack tactics are determined by considering the threat, target size and vulnerability, the weather, the terrain, accuracy requirements, weapons effectiveness, and fragmentation patterns.

- **Hovering Fire.** Hovering fire is performed when the aircraft is stationary or has little forward motion. Aircrews perform hovering fire after unmasking from a defilade position. To prevent being targeted by enemy weapons, aircrews maintain the hovering fire position for only short periods. Indirect hovering fire should be delivered from FPs hidden from the enemy by terrain features. After delivering hovering fire, aircrews remask behind terrain. If the terrain permits, aircrews should move to an alternate FP. Unguided ordnance (rockets, cannons, or 20-/25-/30-mm gunfire) is normally less accurate because the aircraft is less stable in a hover. Precision-guided weapons are the most effective ordnance fired from a hover.

- **Running Fire.** Running fire is performed when the aircraft is in level, forward flight. Forward flight adds stability to the aircraft and improves the accuracy of weapon delivery. Running fire used at TERF altitudes reduces an aircrew's vulnerability to enemy air defenses. Running fire offers a moving target and produces a smaller dust or debris signature than is produced in hovering fire. While performing running fire, aircrews can use direct or indirect fire techniques. Aircrews must be constantly aware of the direction and trajectory of all ordnance to be released. Running fire attacks may require the aircraft to fly outside the BP to effectively engage targets. This will necessitate clearance from the terminal controller after coordination and deconfliction with other supporting arms.

- **Unmasked Fire.** Unmasked fire is a combination of running and diving fire. Aircrews climb slightly and then perform a shallow-angle dive. Unmasked fire provides aircrews with the protection from enemy air defenses of running fire and the increase in accuracy of diving fire.

- **Diving Fire.** Diving fire is delivered while the aircraft is at altitude and in descending forward flight. If delivering unguided ordnance, diving fire may produce the most accurate results. Diving fire should be used if the aircrew can remain above or outside the threat envelope. Diving fire is particularly useful in a small-arms or limited-air-defense threat environment.

Scout/Attack Team Tactics

Scout/attack teams provide a highly mobile, powerful, combined-arms capability while executing CAS. They consist of two or more rotary-wing aircraft acting in the scout and attack roles. This capability allows the scout/attack team to quickly and effectively react to a rapidly changing battlefield. Commanders can use the scout/attack team separately, as a reinforcing asset, or reinforced with other assets. Team elements consist of:

- **Scout Element.** The scout element contains one or more rotary-wing aircraft. Multiple aircraft are preferred to provide mutual support within the scout element. The AMC is normally a member of the scout element. He is responsible for CAS mission planning and execution. The AMC's duties include providing liaison and coordination between the scout/attack team and the supported unit to receive the current situation and mission brief, providing reconnaissance of the HA and BP if time and threat permit, briefing the attack element, planning and coordinating target marking/designation, providing security for the attack element from ground and air threats, and controlling the mission's supporting arms.

- **Attack Element.** The attack element contains a minimum of two rotary-wing aircraft. The attack element is subordinate to the mission commander. The attack element leader's duties include assuming all the duties of the mission commander if required and attacking specified CAS targets with the proper ordnance.

DISENGAGEMENT AND EGRESS

Following the attack, the CAS flight disengages and egresses from the BP. Egress instructions may be as detailed as ingress instructions. Egress fire support coordination and deconfliction requirements are the same as those used during ingress. On mission completion, the flight can:

- Proceed to an alternate BP
- Return to the HA for further operations
- Return to the FARP for refueling/rearming
- Return to the FOB/ship.

ROTARY-WING LASER-GUIDED SYSTEMS EMPLOYMENT

The AGM-114 HELLFIRE missile allows attack helicopters to engage targets with precision LGWs. Aircrews use the HELLFIRE system to engage critical hardpoint targets at extended ranges. The HELLFIRE system provides the ability to engage multiple targets simultaneously, allows aircrews to select or change missile-seeker PRF codes from the cockpit, increases standoff and lethality, and reduces the risk to aircrews by reducing or eliminating exposure time. Figure 4-18 illustrates an example of a HELLFIRE designator exclusion zone. HELLFIRE employment considerations include designator/launcher separation angle, aircrew/designator coordination, weather effects and obscurations, and enemy countermeasures.

Figure 4-18. HELLFIRE Designator Exclusion Zone.

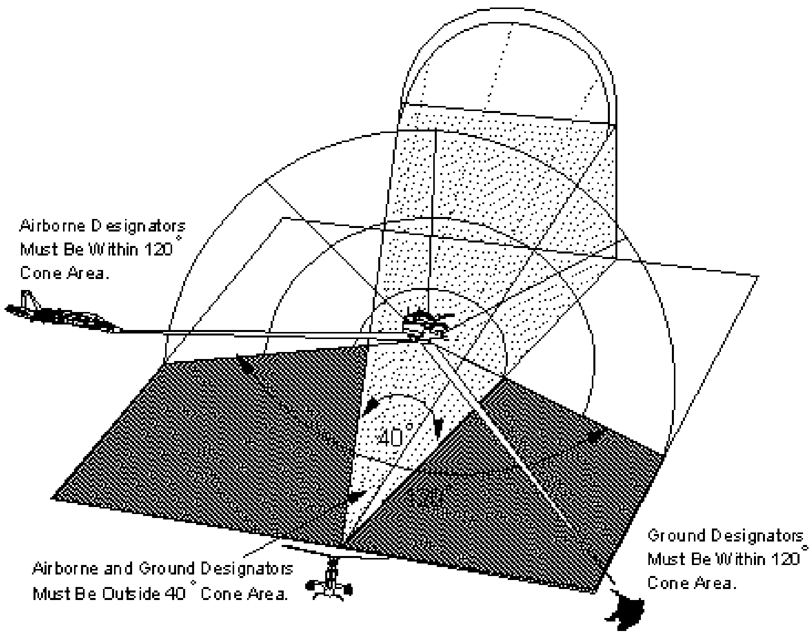
Coordination

When coordinating engagement procedures for HELLFIRE-equipped aircraft, terminal controllers and aircrews consider the following factors:

- Communications between the terminal controller, laser designator, and aircrews must be adequate.
- The terminal controller must provide accurate target location information and laser-to-target line to the aircrew.
- The PRF code settings must be coordinated before the attack.
- The number of missiles and the interval between missiles for rapid or ripple fire must be decided.
- Proper geometry between the laser, the target, and the attack aircraft must exist to maximize the probability of kill.

Characteristics

The HELLFIRE LGM homes on targets designated by U.S. and NATO laser designators. The HELLFIRE system should use PRF codes in the range of 1111 to 1688 to achieve the desired probability of a hit. The HELLFIRE system allows the aircrew to conduct multiple, rapid launches by using one or two designation codes simultaneously. The aircrew can set or change the PRF code from the cockpit. If using a single designator, the aircrew delays launching subsequent missiles (all set on the same PRF code) until the terminal controller shifts the laser designator to the next target. If using two designators (each set to a different PRF code), the missile launch interval can be less than 2 seconds. The use and coordination



of multiple designators presents a complex problem for the aircrew and the terminal controllers.

HELLFIRE Missile Lock-On Options

- **Lock-On Before Launch (LOBL).** Aircrews use the LOBL mode of fire to launch missiles after they have locked onto and tracked the properly coded reflected laser energy. The LOBL method requires direct line of sight from the missile to the target. Terminal controllers and aircrews use LOBL when they want to confirm that the aircraft is within launch parameters before launch. LOBL allows a higher probability of kill against obscured or close-range targets. LOBL should be used when the threat does not require delayed designation (laser countermeasures) or launch from a defilade position.

- **Lock-On After Launch (LOAL).** Aircrews use the LOAL mode of fire to launch missiles without acquiring or locking onto any laser energy. Lock-on occurs after the aircrew launches the missile. LOAL allows the aircrew to launch missiles without exposing themselves to the threat. Three trajectories are available for LOAL launch: low (LOAL LO), high (LOAL HI), direct (LOAL DIR). The trajectory selected depends on terrain obstacles and the distance to the target. The LOAL LO mode allows the missile to clear a low terrain obstacle. The LOAL HI mode allows the missile to climb to a higher altitude to clear a high terrain obstacle. Aircrews use the LOAL DIR mode when the target is within line of sight but enemy countermeasures prevent designation before launch or when the cloud ceiling is low.

Types of HELLFIRE Delivery

- **Direct Fire.** Direct fire can be used for either the LOBL or LOAL options. The LOBL option requires direct line of sight to the target and seeker lock-on before launch. If the target is not designated by the delivery aircraft, the aircrew can fly behind terrain after missile launch.

- **Indirect Fire.** Aircrews use indirect fire to fire the missile before achieving lock-on (LOAL). The aircrew launches the missile while the aircraft is masked. Aircrews can also use indirect fire when the missile cannot receive the laser energy reflecting off the target because of distance. The aircrew launches the missile in a preprogrammed sequence that causes it to fly an elevated trajectory. The missile then locates and locks onto the laser-reflected energy of the designated target.

HELLFIRE Attacks on Multiple Targets

Multiple missiles attacking multiple high-threat targets reduce aircrew exposure and laser operating time. During multiple launches, the aircrew normally fires the missiles at an 8-second (minimum) interval. Longer intervals can be used based on experience, terrain, target array, and battlefield obscuration. During target attacks, the terminal controller must be sure that subsequent missiles can receive reflected laser energy without interruption. Dust and smoke from initial detonations can block or interrupt the reception of laser energy by follow-on missiles. The terminal controller should consider wind speed and direction when selecting multiple targets. Multiple missile launches require close coordination and timing.

SECTION VI. RETURN-TO-FORCE

PROCEDURES

Procedures must be established to allow friendly aircraft to safely move in, out, and through airspace within the area of operations. Planning for friendly air operations to support the MAGTF while concurrently protecting it from enemy air attack is a difficult task. Control procedures must be thoroughly examined, especially for safe passage of friendly aircraft through restricted areas and back through the friendly integrated air defense system. The use of these control procedures should maximize the safety of the defended area while minimizing the possibility of fratricide. Return- to-force (RTF) procedures are based on the threat, friendly posture, friendly aircraft capabilities, and weather. RTF control procedures include the use of:

- Ingress/egress corridors and routes for both helicopters and fixed-wing aircraft (examples of these corridors and routes include low-level transit routes (LLTRs) and minimum risk routes (MRRs))
- Control points
- Visual identification (VID)
- Electronic identification via noncooperative target recognition (NCTR)
- The tactical air navigation (TACAN) system
- IFF equipment
- Altitude and air speed restrictions

- Lame-duck procedures (when aircraft have no communications, no IFF, battle damage, etc.)
- ACAs.

See MCWP 3-22, *Antiair Warfare*, for more information on RTF procedures.

DEBRIEFING

On completing the mission, aircrews should debrief the salient aspects of the flight. The debriefing can provide valuable information by evaluating the mission and its effect on the enemy, enemy resistance, and enemy tactics and techniques. Successes should be highlighted and expanded on to aid in future CAS missions. Difficulties and failures should be identified and the appropriate corrections made to prevent further occurrences. Key points and items of importance should be passed on during the intelligence and operations section debriefs of the aircrew. The information obtained can aid in planning and executing future MAGTF operations.